Title

Implementation of a New CT Hardware and Software Platform: Reducing Radiation Doses in Computed Tomography (CT).

LCDR Zachary Alexander[1] MC USN, Jude Rosario[2]

[1-2]Department of Radiology; [1-2]Naval Hospital Camp Pendleton

Introduction

As the number of CT examinations performed at Naval Hospital Camp Pendleton (NHCP) has increased annually, anxieties regarding the effects of medical radiation exposure have also increased. Public awareness and fear concerning the risks of medical radiation has grown significantly over the past few years. High radiation doses coupled with increased utilization of medical imaging services has fueled a high demand of action by the mainstream media as well as the scientific community. While patients become more educated about the risks associated with radiation exposure, medical professionals are under increased pressure to justify imaging procedures and reduce radiation dose from indicated procedures.

The lifetime cancer risk based on current CT usage has been estimated to be as high as 2.0%[2]. Cumulative risks may be even higher for certain adult patient populations, particularly for those requiring multiple or multiphase studies, as well as in obese patients requiring increased radiation dose for adequate tissue penetration[2].

Recent innovations in medicine, technology, and the field of radiology are expanding the role and responsibilities of the Computed Tomography technologist to produce more complex and time consuming examinations, often requiring multiple scans and different contrast phases in a single exam. Breakthrough advances are making the diagnosis of illnesses more accurate, but the prospective increased radiation doses necessary to achieve more sensitive diagnostic data has been viewed as a consequential disadvantage.

Objective

The goal of this project was to reduce total radiation dose received by patients from Computed Tomography (CT) scans performed at Naval Hospital Camp Pendleton.

Methods

Over a three month period prior to the improvement, the Department of Radiology performed an analysis of CT scans of the head, abdomen/pelvis, and chest angiograms. Results demonstrated that the radiation dose NHCP patients received from these three common study types was slightly higher than the national average (Figure 1).

Working in conjunction with local vendor specialists, NHCP became the first military treatment facility to install a new CT hardware and software platform upgrade to Computed Tomography, as well as the first institution in the nation to install this upgrade on the native 64-slice CT scanner. The software platform utilizes a complex mathematical algorithm which processes the images after the CT scan is performed to provide equivalent diagnostic image quality with the same appearance as full-dose images at a fraction of the dose. Once installed, the radiologist can then use the software to either dramatically improve image quality at the same radiation dose as before, or reduce the radiation dose received from CT scans and still get images of the same quality.

NHCP Radiology has focused on using this innovation to reduce radiation doses from CT scans. Working with local manufacturer engineers, a careful review of our imaging protocols to improve efficiency and refine image acquisition and quality has also led to: 1) a reporting system to monitor individual patient radiation doses, as required by the Joint Commission; 2) a periodic dose-usage reporting system to raise awareness and enhance clinical knowledge in the workplace; and 3) a tracking system for monitoring and evaluating examinations that can be used for staff training.

Results

Following the installation of the upgrade and optimization of imaging protocols, CT scans performed at NHCP have demonstrated a dramatic reduction in radiation dose. NHCP has realized a radiation dose reduction on adult Head CT, Chest CT Angiography, and Abdomen/Pelvis CT to below national averages, including a 25.8% reduction in Head CT doses, a 27.1% reduction in Abdomen/Pelvis CT doses, and a 41.0% reduction in radiation dose received from Chest CT Angiography (Figure 2).

With lower dose imaging achieved, we also realized that faster scans are of utmost importance to increase patient comfort and improve temporospatial imaging. Focusing primarily on pediatric and trauma protocols, NHCP Radiology was able to further improve imaging protocols to obtain high-quality images using a fraction of the dose acquired at as much as twice the speed. The resulting improvement eliminated the need for multiple scans and multiple radiation doses on otherwise clinically challenging patients.

At the end of each examination, newer structured dose report guidelines have documented all patient dose values to alert technicians to potential errors and best practices. Altogether, this process has made it easier for NHCP Radiology to manage dose reporting under stricter guidelines as set forth by the Joint Commission.

NHCP Radiology's compliance with the Joint Commission standards for "Record of care, treatment, and services" has been greatly improved by instituting a program to monitor and reduce total radiation dose received from CT scans.

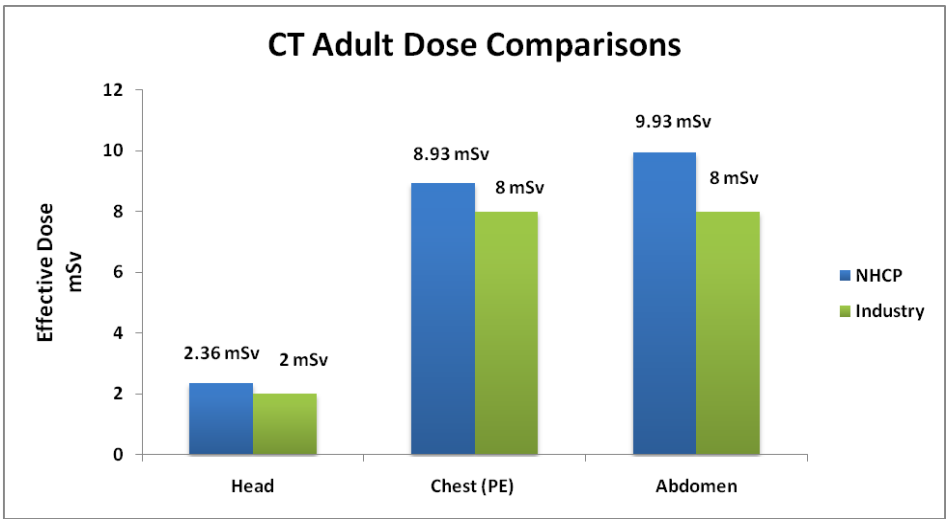

Figure 1.

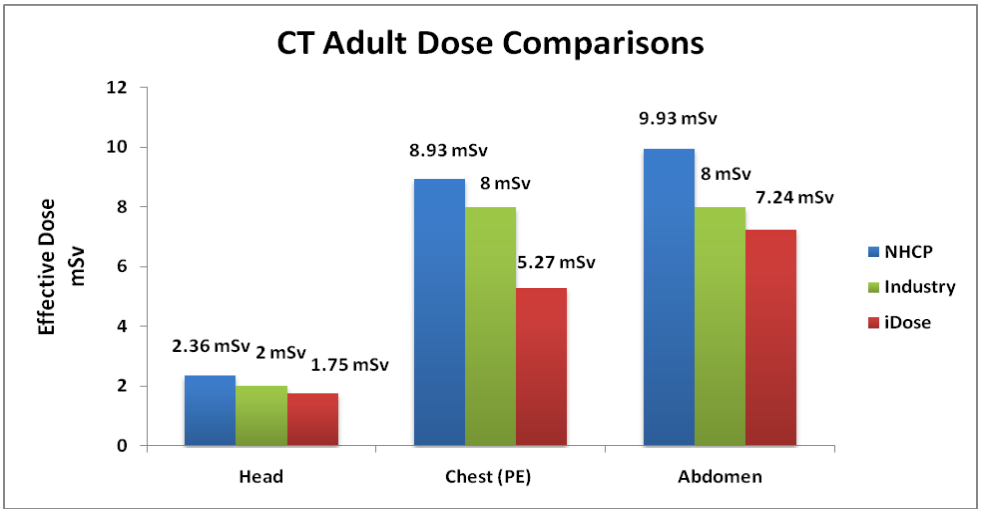

Figure 2.

Conclusions

The rise in utilization of medical imaging, increased public awareness and numerous recent anecdotes[1] about medical radiation exposures have compelled NHCP Radiology to make major improvements in the diagnosis and treatment of our patients. While the performance and power of the Computed Tomography platform has resulted in a rise in medical imaging, the upgradability and flexibility of the platform has allowed the development and implementation of new functions for reducing the risk of acute and potential long-term damage from radiation exposure improving the standard of care. Further adjustments also simplified time-consuming, complex procedures, such as patient scanning and post-scanning image reconstructions. This has been especially beneficial for infants, children, women of child-bearing age, and patients with

multiple examinations. Ultimately, staff members have become more confident in easing patients' concerns about radiation exposure.

Our vision is to continue developing and refining our Computed Tomography protocols at NHCP, comparing our benchmarks to industry standards, and implement a process to coordinate with other military treatment facilities to improve their technology and processes to bring about further dose reduction. This underlines NHCP Radiology's commitment to adhere to the Joint Commission's directive to "raise awareness among staff and patients of the increased risks associated with cumulative doses and [provide] the right test and the right dose through effective processes, safe technology and a culture of safety."[3]

References:

1. Natural News Network. (2011). *Radiation exposure news, articles and information:*. Retrieved November 10, 2011, from Natural News: http://www.naturalnews.com/radiation_exposure.html

2. Silva AC, Lawder H J, Hara A, Kujak J, & Pavlicek W. (2010). Innovations in CT Dose Reduction Strategy: Applicationof the Adaptive Statistical Iterative Reconstruction Algorithm. *American Journal of Roentenology* , 191-199.

3. The Joint Commission. (2011). *The Joint Commission Sentinel Event Alert: Radiation risks of diagnostic imaging.* Retrieved November 5, 2011, from Joint Commission: http://www.jointcommission.org/assets/1/18/SEA_471.PDF